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Engineered symbionts to safeguard honeybee health and their pollination services: A response

Edward A. D. Mitchell, Alexandre Aebi, Francisco Sanchez-Bayo, Dave Goulson, Noa Simon Delso, Robert Brodschneider, Jean-Marc Bonmatin, Maarten Bijleveld van Lexmond, Klaus-Werner Wenzel, Boris Baer, Gérard Arnold, Michael Eyer, Anton Safer

Leonard et al. (1) presented an interesting approach to limit the impact of pathogens on honeybees by stimulating immunity via engineered symbionts. The urgency to safeguard pollinator services is undoubted. Massive declines in bees, insects in general, pose major concerns for ecosystem stability and food production.

However, we see potential pitfalls in such technology driven approaches.

Leonard et al. attribute high honey bee colony mortality to the parasitic mite *Varroa destructor* via synergistic interactions with RNA viruses. However, *Varroa* is only a significant concern for honeybees. The consensus is that pollinator declines are driven primarily by habitat loss and exposure to pesticides (2, 3). The proposed measures will do nothing to aid other insects delivering the bulk of pollination (e.g. (4)).

We caution the release of genetically modified organisms into bees and their environments and identify three main risks:

1. Potential spill over and unknown impact to the health of wild bees. The benefit to bees is thus uncertain.
2. Unpredictable effects for biodiversity, ecosystems and human health: It is impossible to exclude that bacteria with modified genes may cross the species borders through horizontal gene transfer to other microorganisms in the microbiome of bees, other invertebrates, and vertebrates including humans.
3. Potential regulatory and economic consequences: What would happen if traces of GMOs are detected in honey or bee products? Labelling of honey and other bee products as GMOs may be required. This would represent a major blow to beekeepers, a commercial and image disaster.

Efficient *Varroa* control methods or other hive management practices are available to reduce the impact of viruses and colony losses, without the risk of spilling genetically modified organisms.

We propose a discussion to evaluate possible pathways seeking solutions for the pollinator crisis. Broader approaches embracing conservation, socioeconomics and ethical aspects are required.

References

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